

APPENDIX A

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
School of Engineering Faculty Personnel Record

Date: April 7, 2000

Name: J. Kenneth Salisbury, Jr.

Department: Mechanical Engineering

1. Date of Birth: July, 12, 1951

2. Citizenship: U.S.

3. Education:

School	Degree	Date
Stanford University	B.S. (Electrical Engineering)	Jun 1975
Stanford University	M.S. (Mechanical Engineering)	Dec 1977
Stanford University	Ph.D. (Mechanical Engineering)	Jun 1982

4. Title of Thesis for Most Advanced Degree

Kinematic and Force Analysis of Articulated Mechanical Hands

5. Principal Fields of Interest

Electro-Mechanical Systems Design and Control; Kinematics;
 Robotic, Telerobotic and Haptic Systems; Human/Machine Interfaces.

6. Name and Rank of Other Department Faculty in the Same Field

Haruhiko Asada, Professor
 Steven Dubowsky, Professor
 Ian Hunter, Professor
 Jean-Jacques Slotine, Professor
 Mandayam Srinivasan, Principal Research Scientist

7. Name and Rank of faculty in Other Departments in the Same Field

Tomás Lozano-Pérez, Professor (EECS)
 Mark Cutkosky, Associate Professor (ME, Stanford)
 Oussama Khatib, Associate Professor (CS, Stanford)
 Robert Howe, Associate Professor (DAS, Harvard)
 Gill Pratt, Associate Professor (EECS)

8. Non-M.I.T. Experience (including military service)

Employer	Position	Beginning	Ending
Hewlett-Packard, APD	R&D Engineer	Jun 1973	Sep 1974
NASA/Ames Research Center	Research Assistant	Jul 1975	Aug 1976
SRI International	Research Engineer	Oct 1976	Aug 1977
Stanford University AI Lab	Research Assistant	Oct 1977	Jun 1982
Salisbury Robotics, Inc.	President and Founder	Jun 1982	May 1997
Intuitive Surgical, Inc.	Fellow and Scientific Advisor	Sep 1997	present
Stanford University	Visiting Scholar	June 1999	July 1999
Stanford University	Acting Professor of Research	Sept 1999	Present

9. History of M.I.T. Appointments:

Rank	Beginning	Ending
Principal Research Scientist, Mechanical Engineering	Jul 1991	—
Research Scientist, Artificial Intelligence Lab	Oct 1982	Jun 1991
Lecturer, Mechanical Engineering	Sep 1985	Jun 1991

10. Consulting Record

Firm	Beginning	Ending
NASA/JPL	Aug 1978	1989
GTE Laboratories	Nov 1981	(1 day)
Thinking Machines Corp.	Nov 1984	(1 day)
General Motors	May 1984	(1 day)
Arthur D. Little Corporation	May 1985	Apr 1988
Rockwell International Corp.	Apr 1986	(1 day)
ILC Space Systems	May 1987	(2 days)
Grumman Aerospace Corp.	Oct 1988	(3 days)
Intelligent Automation Systems	Apr 1990	(2 days)
Transitions Research Corp.	Oct 1990	(2 days)
Barrett Design, Inc.	Jan 1993	(1 day)
Product Genesis, Inc.	Feb 1993	(1 day)
EXOS, Inc.	Jan 1991	1993
Sensable Technologies, Inc.	Jan 1996	Oct 1999
Intuitive Surgical, Inc.	May 1996	Aug 1997

11. Dept. and Inst. Committees, Other Assigned Duties

Activity	Beginning	Ending
Graduate Counselor (ME Dept.)	Oct 1982	—
Graduate Counselor (EECS Dept.)	Oct 1983	—
Undergraduate Counselor (ME Dept.)	Sep 1989	Aug 1997

12. Government Committees, Service, Etc.

Activity	Beginning	Ending
Editorial Board, <i>Robotics Review</i>	Mar 1987	Dec 1992
Program Committee, NATO Workshop on "Robotics with Redundancy: Design, Sensing and Control"	Jan 1988	Jun 1988
Organizational Committee, International Symposium on Experimental Robotics	Jun 1989	—
Associate Editor, <i>PRESENCE: Teleoperators and Virtual Environments</i>	Jan 1991	Sep 1995
Editorial Board, <i>PRESENCE: Teleoperators and Virtual Environments</i>	Oct 1995	—
Co-Chairman, 4th International Symposium on Experimental Robotics	May 1993	Jun 1995
Program Committee, 1995 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS '95)	Sep 1994	Aug 1995
Program Committee, International Symposia on Medical Robotics and Computer Assisted Surgery (MRCAS 94-97)	Jan 1994	Feb 1996
Scientific Review Committee, International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI)	Feb 1996	—
Program Committee, SPIE Conferences on Telerobotics and Telemanipulator Technology. (96,97)	Dec 1995	Nov 1997
Program Committee, International Conference on Advanced Robotics. (96,97)	Aug 1995	Jul 1997
Co-Chair, PHANToM Users Group Workshops (1 through 4)	Aug 1996	1999
Program Committee, ACM Symposium on Interactive 3D Graphics	Jul 1997	—
Program Committee, Symposium on Haptic Interfaces Virtual Environment and Teleoperator Systems	Jan 2000	—
Organizing Board Member, IEEE ICRA 2000	Jun 1999	Apr 2000
Executive Technical Advisory Council, MICCAI 2000	Jul 1999	Nov 2000

13. Awards Received

Award	Date
BS degree award "with distinction" from Stanford Univ.	Jun 1975
O. H. Shuck Award for the best paper at the 1981 Joint Automatic Control Conference, "Best Paper of Conference," ASME Design and Production Engineering Technical Conference	Oct 1981
"Best Robotics Thesis of 1983," awarded by the System Development Foundation.	Sep 1982
"NASA Certificate of Recognition," issued for development of Multi-Fingered Robotic Hand by Inventions and Contributions Board of NASA.	Sep 1984
Finalist, <i>Discover Magazine</i> Technical Innovation of the Year	Apr 1987
Lemelson-MIT Student Prize, Awarded to Advisee, Thomas Massie	1995
Lemelson-MIT Student Prize, Awarded to Advisee, Akhil Madhani	1995
MIT WAM Arm named "Most Advanced Robotic Arm by the Guinness Book of World Records, 2000 Edition"	1998
	Jan 2000

14. Current Organization Membership

Organization	Offices Held
Tau Beta Pi, member	awarded 1974
Institute of Electrical and Electronic Engineers, member	since 1976
American Society of Mechanical Engineers, member	since 1977

15. Patents and Patent Applications Pending

1. U.S. Patent 4,160,508, "An Improved Controller Arm for a Remotely Related Slave Arm," J. Kenneth Salisbury, Jr. Issued Jul 10, 1979.
2. U.S. Patent 4,635,479, "Force Sensing Apparatus," J. Kenneth Salisbury, Jr. and David L. Brock. Issued Jan 13, 1987.
3. U.S. Patent 4,903,536 "Compact Cable Transmission with Cable Differential," J. Kenneth Salisbury, Jr., et al. Issued Feb 27, 1990.
4. U.S. Patent 4,921,293, "Multi-fingered Robot Hand," Carl Ruoff and J. Kenneth Salisbury, Jr. Issued May 1, 1990.
5. U.S. Patent 5,046,375 "Compact Cable Transmission with Cable Differential," J. Kenneth Salisbury, Jr., et al. Issued Sep 10, 1991.(continuance of 4,903,536)
6. U.S. Patent 5,207,114 "Compact Cable Transmission with Cable Differential," J. Kenneth Salisbury, Jr., et al. Issued May 4, 1993. (continuance of 4,903,536)
7. U. S. Patent 5,327,790 "Torque Sensing Actuator," Mike D. Levin and J. Kenneth Salisbury, Jr. Issued Jul 12, 1994.
8. Foreign patents pending for "Whole-Arm Manipulator," J. Kenneth Salisbury, Jr., et al. Filed Apr 21, 1988.
9. U.S. Patent 5,587,937 "Force Reflecting Haptic Interface," Thomas H. Massie and J.Kenneth Salisbury, Jr. Issued Dec 24, 1996. (continuation of 5,625,576)
10. U.S. Patent 5,625,576 "Force Reflecting Haptic Interface," Thomas H. Massie and J.Kenneth Salisbury, Jr. Issued Apr 29, 1997.
11. U.S. Patent Pending, "Method and Apparatus for Determining Forces to be Applied to a User Through a Haptic Interface," Zilles, Salisbury, Massie, Brock, Srinivasan and Morgenbesser, Filing Date: 4/4/96, USSN: 08/627,432.
12. U.S. Patent 5,792,135, "Articulated Surgical Instrument for Performing Minimally Invasive Surgery with Enhanced Dexterity and Sensitivity," Madhani, Akhil J. and Salisbury, J. Kenneth. Issued Aug 11, 1998.
13. U.S. Patent 5,797,900, "Wrist Mechanism for Surgical Instrument for Performing Minimally invasive Surgery with Enhanced Dexterity and Sensitivity," Madhani, Akhil J. and Salisbury, J. Kenneth. Issued Aug. 25, 1998.
14. U.S. Patent 5,807,377, "Force-reflecting surgical instrument and positioning mechanism for performing minimally invasive surgery with enhanced dexterity and sensitivity," Madhani, Akhil J. and Salisbury, J. Kenneth. Issued Sept. 15, 1998.
15. U.S. Patent 5,898,599 "Force Reflecting Haptic Interface," Thomas H. Massie and J.Kenneth Salisbury, Jr. Issued Apr. 27, 1999. (continuation of 5,625,576)

16. U.S. Patent 5,976,122 "Articulated Surgical Instrument for Performing Minimally Invasive Surgery with Enhanced Dexterity and Sensitivity," Madhani, Akhil J. and Salisbury, J. Kenneth. Issued Nov. 2, 1999. (continuation of 5,792,135)

16. Professional Registration:

ASME
IEEE

Teaching Experience of J. Kenneth Salisbury, Jr.

Term	Subject Number	Title	Role
FT86	2.70	Introduction to Design	Instructor
FT87	2.70	Introduction to Design	Instructor
FT88	2.70	Introduction to Design	Instructor
Mar 1990		Introduction to Robot Kinematics, Design and Control (one week intensive course as visiting Professor at Scuola Superiore "S. ANNA" Pisa ITALY)	Lectures/Development
IAP90	6.911	"6.270" Robot Design Competition	Sponsor
ST90	2.70	Introduction to Design	Instructor
IAP91	6.911	"6.270" Robot Design Competition	Sponsor
ST91	6.802	Robot Manipulation	Instructor in charge
FT92	2.671	Mechanical Lab	Co-instructor
ST92	2.70	Introduction to Design	Instructor
IAP93	2.971	Machine Shop Practice	Co-instructor
ST93	2.70	Introduction to Design	Instructor
ST94	2.70	Introduction to Design	Instructor

Publications of J. Kenneth Salisbury, Jr.

1. Books

1. Mason, M.T. and J.K. Salisbury, *Robot Hands and the Mechanics of Manipulation*, M.I.T. Press, Cambridge, MA, 1985.
2. Khatib, O. and J.K. Salisbury, (Eds) *Experimental Robotics IV: The 4th International Symposium*, (Lecture Notes in Control and Information Sciences; 233), Springer-Verlag, 1997.
3. Srinivasan, M., Cutkosky, M., Howe, R. and Salisbury, J.K., "Human and Machine Haptics," MIT Press, to appear Fall 2000.

2. Papers in Refereed Journals

1. Salisbury, J.K. and J.J. Craig, "Articulated Hands: Force Control and Kinematic Issues," *International Journal of Robotics Research*, Vol. 1, No. 1, MIT Press, Cambridge, MA, Spring 1982, pp. 4-17.
2. Salisbury, J.K. and B. Roth, "Kinematic and Force Analysis of Articulated Mechanical Hands," *ASME Journal of Mechanisms, Transmission and Automation in Design*, Vol. 105, Mar 1983, pp. 35-41.
3. Bejczy, A.K. and J.K. Salisbury, "Controlling Remote Manipulators Through Kinesthetic Coupling," *ASME Computers in Mechanical Engineering*, Vol. 2, No. 1, Jul 1983, pp. 48-60.
4. Salisbury, J.K., "Issues in Human/Computer Control of Dextrous Remote Hands," *Transactions on Aerospace and Electronic Systems*, 24:5, Sep 1988, pp. 591-596.
5. Townsend, W.T. and J.K. Salisbury, "The Efficiency Limit of Belt and Cable Drives," *ASME Journal of Mechanisms, Transmissions, and Automation in Design*, Vol. 110, pp. 303-307, Sep 1988.¹
6. Bicchi, A., J.K. Salisbury and D.L. Brock, "Contact Sensing from Force Measurements," *International Journal of Robotics Research*, Vol. 12 No. 3., June, 1993, pp. 249-262. (also MIT AI Lab Memo No. 1262, Oct 1990.)
7. Eberman, B. and Salisbury, J.K., "Application of Change Detection to Dynamic Contact Sensing," *International Journal of Robotics Research*, Vol. 12, No. 5, October 1994, pp. 369-394. ¹
8. Salisbury, J.K. and Srinivasan, M.A., "Phantom-Based Haptic Interaction with Virtual Objects," *IEEE Computer Graphics and Applications*, Vol. 17, No. 5, September-October 1997, pp. 6-10.
9. Morrell, J.B. and Salisbury, J.K., "Parallel Coupled Micro-Macro Actuators," *International Journal of Robotics Research*, Vol. 17, No. 7, July 1998, pp. 773-791. ¹
10. Salisbury JK: The heart of microsurgery. *Mechanical Engineering Magazine*, ASME Int'l. 1998 Dec; 120(12): 47-51
<http://www.memagazine.org/backissues/december98/features/microheart/microheart.html>

¹Outgrowth of theses supervised by J. Kenneth Salisbury, Jr.

11. Salisbury, J.K., "Making Graphics Physically Tangible," *Communications of the ACM*, Vol. 42, No. 8, August 1999, pp. 75-81.
12. Falk, V, McLoughlin J, Guthart G, Salisbury K, Walther T, Gummert J, Mohr F, "Dexterity Enhancement in Endoscopic Surgery by a Computer Controlled Mechanical Wrist," *Min Inv Therapy & Allied Technol*, 1999: 8(4) 235-242.

3. Proceedings in Refereed Conferences

1. Bejczy, A.K. and J.K. Salisbury, "Controlling Remote Manipulators Through Kinesthetic Coupling," *Proceedings of ASME Computer Technology Conference*, San Francisco, Aug 1980.
2. Salisbury, J.K., "Active Stiffness Control of a Manipulator in Cartesian Coordinates," *19th IEEE Conference on Decision and Control*, Albuquerque, NM, Dec 1980, pp. 83-88. (Accepted for Publication by *IEEE Transactions on Pattern Analysis and Machine Intelligence*)
3. Salisbury, J.K. and B. Roth, "Kinematic and Force Analysis of Articulated Mechanical Hands," *Proceeding of ASME Design and Production Engineering Technical Conference*, Washington D.C., Sep 1982.
4. Salisbury, J.K. "Interpretation of Contact Geometries from Force Measurements," *Proceedings 1st Int. Symp. on Robotics Research*, Bretton Woods, NH, MIT Press, Sep 1984, pp. 565-577.
5. Salisbury, J.K. "Interpretation of Contact Geometries from Force Measurements," *Proceedings 1st IEEE International Conference on Robotics*, Atlanta GA, Mar 1984, pp. 240-247.
6. Salisbury, J.K. "Design and Control of an Articulated Hand," *Proceedings International Symposium on Design and Synthesis*, Tokyo, Japan, Jul 1984, pp. 459-466.
7. Salisbury, J.K. and J.D. Abramowitz, "Design and Control of a Redundant Mechanism for Small Motion", *Proceedings 2nd IEEE International Conference on Robotics and Automation*, St. Louis, MO, Mar 1985, pp. 323-328. ¹
8. Salisbury, J.K., D.L. Brock and S.L. Chiu, "Integrated Language, Sensing and Control for a Robot Hand", *Proceedings 3rd International Symposium on Robotics Research*, MIT Press, 1986, pp. 389-396.
9. Salisbury, J.K., "Issues in Human/Computer Control of Dextrous Remote Hands," *Proceedings NASA/JPL Workshop on Space Telerobotics*, Pasadena, CA, Jan 1987.
10. Townsend, W.T. and J.K. Salisbury, "The Effect of Coulomb Friction and Stiction on Force Control," *IEEE International Conference on Robotics and Automation*, Raleigh, NC, Apr 1987, Vol. 2. pp. 883-889. ¹
11. Salisbury, J.K., "Whole Arm Manipulation", *Proceedings 4th International Symposium on Robotics Research*, Santa Cruz, CA, Aug, 1987.
12. Salisbury, J.K., W.T. Townsend, B.S. Eberman, D.M. DiPietro, "Preliminary Design of a Whole-Arm Manipulation System (WAM)," *Proceedings 1988 IEEE International Conference on Robotics and Automation*, Philadelphia, PA, Apr 1988, pp. 254-260.
13. Salisbury, J.K., "Design of an Actively Compliant Manipulator," *Proceedings of International Ocean Technology Congress*, Honolulu, HI, Jan 1989.

14. Bicchi, A., J.K. Salisbury and P. Dario, "Augmentation of Grasp Robustness Using Intrinsic Tactile Sensing," *Proceedings of the 1989 IEEE International Conference on Robotics and Automation*, Scottsdale, AZ, Apr 1989, , Vol. 1, pp. 302-307.
15. Townsend, W.T. and J.K. Salisbury, "Mechanical Bandwidth as a Guideline to High-Performance Manipulator Design," *Proceedings of the 1989 IEEE International Conference on Robotics and Automation*, Phoenix, AZ, Apr 1989, Vol. 3, pp. 1390-1395. ¹
16. Salisbury, J.K., B.S. Eberman, M.D. Levin and W.T. Townsend, "The Design and Control of an Experimental Whole-Arm Manipulator," *Proceedings of the 5th International Symposium on Robotics Research*, Tokyo, Japan, Aug 1989, pp. 233-241.
17. Eberman, B.S. and J.K. Salisbury, "Determination of Manipulator Contact Information from Joint Torque Measurements," *Experimental Robotics I, First International Symposium*, Montréal, Canada, Jun 1989. Published in *Lecture Notes in Control and Information Sciences*, Hayward, V. and O. Khatib (Eds.), Springer-Verlag, 1990, pp. 463-473. ¹
18. Brock, D.M. and J.K. Salisbury, "Implementation of Behavioral Control on a Robot Hand/Arm System," *Proceedings of 2nd International Symposium on Experimental Robotics*, Toulouse, France Jun 1991. Springer-Verlag, 1992.
19. Bicchi, Antonio, K. Salisbury and D. Brock, "Experimental Evaluation of Friction Characteristics with an Articulated Robotic Hand," *Proc. Second International Symposium on Experimental Robotics*, Toulouse France, Jun 1991. Springer-Verlag, 1992.
20. Melchiorri, C. and Salisbury, J.K., "An Algorithm for the Control of a Hand-Arm Robotic Systems," *Proceedings of the 5th International Conference on Advanced Robotics*, Pisa, Italy, June 1991, Vol. 1, pp. 471-476.
21. Eberman, B. and K. Salisbury, "Segmentation and Interpretation of Temporal Contact Force Signals" In V. Hayward and O. Khatib, editors, *Experimental Robotics III, Third International Symposium*, Kyoto, Japan, Oct, 1993, pp. 120-131. ¹
22. Salisbury, J.K. and Massie, T., "The PHANToM Haptic Interface," *Proc. of the AAAI Spring Symposium Series Toward Physical Interaction and Manipulation*, Stanford University, Stanford, CA, May 1994, pp. 111-113.
23. Massie, Thomas H. and K. Salisbury, "The PHANToM Haptic Interface: A Device for Probing Virtual Objects," *Proceedings of the ASME Winter Annual Meeting, Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, Chicago, IL, Nov 1994.
24. Salisbury, Kenneth, D. Brock, T. Massie, N. Swarup and C. Zilles, "Haptic Rendering: Programming Touch Interaction with Virtual Objects," *Proceedings of the ACM Symposium on Interactive 3D Graphics*, Monterey, CA, April 1995, pp. 123-130.
25. Morrell, J. and Salisbury, J.K., "In Pursuit of Dynamic Range: Using Parallel Coupled Actuators to Overcome Hardware Limitations," *Proceedings of Experimental Robotics IV: The Fourth International Symposium*, Stanford University, Stanford, CA, July 1995, pp 263-273, Springer-Verlag. ¹

26. Prattichizzo, D., Salisbury, J.K. and Bicci, A., "Grasp Quality Analysis," Proceedings of Experimental Robotics IV: The Fourth International Symposium, Stanford University, Stanford, CA, July 1995, pp 83-90, Springer-Verlag.
27. Zilles, Craig and K. Salisbury, "A Constraint-Based God Object Method for Haptic Display," proceedings of IROS-95, Pittsburgh, Aug 6-9, 1995, Vol. 3, pp 146-151. ¹
28. Morrell, John and K. Salisbury "Parallel Coupled Actuators for High Performance Force Control: A Micro-Macro Concept," Proc. of IROS-95, Pittsburgh, Aug 6-9, 1995, pp. 391-398. ¹
29. Leveroni, Susanna and K. Salisbury, "Reorienting Objects with a Robot Hand Using Grasp Gaits," *Proceedings of the 7th International Symposium on Robotics Research*, Munich, Germany, Oct 1995, pp. 39-51. Springer-Verlag.¹
30. Leveroni, S.R. and J.K. Salisbury, "Cooperative Control Of Multiple Robots to Manipulate Objects," Proceedings of SPIE Photonics East '96 Symposium on Sensor Fusion and Distributed Robotic Agents, Boston, Nov 1996, pp. 2-10. ¹
31. Salisbury J.K., "An Overview of Haptics Research at MIT's AI Lab.," Proceedings of the First PHANTom User's Group Workshop, Eds: J.K. Salisbury and M.A. Srinivasan, AI Technical Report no. 1596, RLE Technical Report No. 612, MIT, 1996, pp. 6-9.
32. Theobald, D.A., W.J. Hong, A. Madhani, B. Hoffman, G. Niemeyer, L. Cadapan, J-J. Slotine, and K. Salisbury, "Autonomous Rock Acquisition," Proceedings of the AIAA Forum on Advanced Development in Space Robotics, Madison, WI, Aug 1-2, 1996.
33. Morrell, John B. and J. Kenneth Salisbury, "Performance Measurements for Robotic Actuators," Proceedings of the ASME Fifth Annual Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems, Atlanta, Georgia, Nov 21-22, 1996, pp. 531-537.¹
34. Leveroni, Susanna, V. Shah and K. Salisbury, "Toward Dexterous Gaits and Hands," *Experimental Robotics V, The Fifth International Symposium*, Spain, June 1997. Springer-Verlag.¹
35. Salisbury, J.K. and Tarr, C., "Haptic Rendering of Surfaces Defined by Implicit Functions," Proceedings of the ASME 6th Annual Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems, Dallas, TX, November 1997, pp. 61-68.
36. Madhani, A.J., Niemeyer, G., and Salisbury, K., "The Black Falcon: A Teleoperated surgical instrument for minimally invasive surgery," Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS-98), Victoria, B.C., Oct. 1998, Vol. 2 pp. 936-944.
37. Akhil J. Madhani, Gunter Niemeyer, J. Kenneth Salisbury, Jr., "Design and Clinical Experience with Teleoperated Minimally Invasive Surgical Robots," Oral Presentation at Medicine Meets Virtual Reality: 7 January 22, 1999.
38. Madhani, A.J., Niemeyer, G., and Salisbury, K., "Macro-Micro Control to Improve Bilateral Force-Reflecting Teleoperation," proceedings of *Experimental Robotics VI, The Sixth International Symposium*, Sydney, March 1999, pp. 357-366. Springer-Verlag.¹

39. Hong, W.J., J.K. Salisbury, "Obstacle Negotiation in Robotic Excavation," IASTED International Conference on Robotics and Applications October 28-30, 1999, Santa Barbara, CA, USA, pp 134-139.
40. Ottensmeyer, Mark P., Ben-Ur, Ela, Salisbury, J. Kenneth. "Input and Output for Surgical Simulation: Devices to Measure Tissue Properties in vivo and a Haptic Interface for Laparoscopy Simulators," Proceedings of Medicine Meets Virtual Reality 2000, Newport Beach, CA. IOS Press. pp236-242. 27-30 Jan 2000.
41. Guthart G.S., and J.K. Salisbury, "The Intuitive Telesurgery System: Overview and Application," to appear, Proc. of the IEEE International Conference on Robotics and Automation (ICRA2000), San Francisco CA, April 2000.
42. Ben-Ur, E and Salisbury, JK. "Development of a 5-DOF force feedback laparoscopic interface for simulation and telesurgery," To appear Proceedings of 2000 SPEI Vol. 4037, Digitization of the Battlespace V and Battlefield Technologies II [4037B-41].
43. Mintz, D., Falk V., and Salisbury K., "Comparison of Three High-End Visualization Systems on Telesurgical Performance," Submitted to MICCAI 2000.

4. Other Major Publications

1. Salisbury, J.K., "Kinematic and Force Analysis of Articulated Hands," Ph.D. dissertation in Stanford University Mechanical Engineering and Computer Science Department, Report No. STAN-CS-82-921, Stanford, CA, Jun 1982.
2. Salisbury, J.K., "Kinematic and Force Analysis of Articulated Hands," in Beni, G. and Hackwood, S., eds., Recent Advances in Robotics, John Wiley and Sons, 1985, 1985, pp. 131-174.
3. Salisbury, J.K. and Craig, J., "Articulated Hands: Force Control and Kinematic Issues," In Whitman R., ed., Natural Computation, MIT Press, 1988, pp. 4-17.
4. Salisbury, J.K., Brock, D. and O'Donnell, P., "Using an Articulated Hand to Manipulate Objects," In Michael, B., ed., Robotics Science, MIT Press, 1989, pp. 540-562.
5. Khatib, O., J.J. Craig and T. Lozano-Pérez, Eds. *The Robotics Review 1*, MIT Press, 1989. Review by J.K. Salisbury, "Experiments in Force Control of Robotic Manipulators," by J.A. Maples and J. Becker.
6. Salisbury, J.K., "Using an Articulated Hand to Manipulate Objects," In Winston, PH and Shellard, SA, eds., Artificial Intelligence at MIT: Expanding Frontiers, Vol. 2, MIT Press, 1990, pp. 211-227.
7. Salisbury J.K., "An Experimental Whole-Arm Manipulator," In Winston, PH and Shellard, SA, eds., Artificial Intelligence at MIT: Expanding Frontiers, Vol. 2, MIT Press, 1990, pp. 229-249.
8. Srinivasan, M. and J.K. Salisbury, "Haptic Interfaces," in *Virtual Reality: Scientific and Technical Challenges*, Eds: N. I. Durlach and A. S. Mavor, Report of the Committee on Virtual Reality Research and Development, National Research Council, National Academy Press, 1994, pp. 161-187.

9. Salisbury, JK and Srinivasan, MA (Eds), "Proceedings of the First PHANToM Users Group Workshop," AI Lab Technical Report No. 1596 and RLE Technical Report No. 612, MIT Dec 1996.
10. Salisbury, JK and Srinivasan, MA (Eds), "Proceedings of the Second PHANToM Users Group Workshop," AI Lab Technical Report No. 1617 and RLE Technical Report No. 618, MIT, Dec 1997.
11. Salisbury, JK and Srinivasan, MA (Eds), "Proceedings of the Third PHANToM Users Group Workshop," AI Lab Technical Report No. 1643 and RLE Technical Report No. 624, MIT, December 1998.
12. Salisbury, JK and Srinivasan, MA (Eds), "Proceedings of the Fourth PHANTOM Users Group Workshop," AI Lab Technical Report No. 1675 and RLE Technical Report No. 633, MIT, November 1999.
13. "Medical Miracles for the Next Millennium," LIFE Magazine Special Issue, Fall 1998. Report on Telesurgical System that Salisbury helped develop.

5. Internal Memoranda and Progress Reports

1. Starr, G. and J.K. Salisbury, "Remote Manipulator Performance Measures and Display Design," NASA/Ames Research Center Report, Nov 1975.
2. Hill, J.W and J.K. Salisbury, "Study to Design and Develop Remote Manipulator Systems," Stanford Research Institute Report, NAS2-8652, Quaterly Reports 7 & 8, May 1977.
3. MIT Industrial Liaison Office, "Dextrous Robot Hand" (video tape of Salisbury Hand) Jun 1985.
4. Townsend, William and J.K. Salisbury, "Model-X Force-Reflecting Hand Controller," MIT AI Lab, Aug 1987.
5. Salisbury, J.K., J.M. Hollerbach, D.L. Brock and D.M. Siegel, "Analysis and Construction of Contact and Tactile Sensors," Contractor report SAND87-7120, Sandia National Laboratories, Jul 1989.
6. Brock, David L. and J.K. Salisbury, "Force Sensing Fingertip Investigation," Progress Report 1, Sandia Contract No. 23-2299, Jul 20, 1989.
7. Chammas, C.Z. and J.K. Salisbury, "Hands: An Automatic Grasping Approach," NASA, Aug 1989.
8. Melchiorri, C., Salisbury, J.K., "Exploiting the Redundancy of a Hand/Arm Robotic System," A.I. Memo No. 1261, Artificial Intelligence Laboratory, M.I.T., Cambridge, MA, Oct 1990.
9. Brock, David L. and J.K. Salisbury, "Contact Sensing Palm for the Salisbury Hand," Progress Report 2, Sandia Contract No. 75-2608, Jun 11, 1990.
10. Chammas, C.Z. and J.K. Salisbury, "Analysis and Implementation of Robust Grasping Behaviors," NASA/JSC Progress Report, Jun 1990.

11. Melchiorri, C. and J.K. Salisbury, "Exploiting the Redundancy of a Hand-Arm Robotic System," AI Memo No. 1261, Oct 1990.
12. Bicchi, A, J.K. Salisbury and D.L. Brock, "Contact Sensing from Force Measurements," MIT AI Lab Memo No. 1262, Oct 1990.
13. Antonio Bicchi, "Criterion for the Optimal Design of Multiaxis Force Sensors," MIT AI Lab Memo No. 1263, October 1990.
14. Brian Eberman and David Brock, "Line Kinematics for Whole-Arm Manipulation," AI Memo No. 1255, January 1991.
15. Zanasi, R and J.K. Salisbury, "Dynamic Modeling, Simulation and Parameter Identification for the WAM Arm," MIT AI Lab Memo No. 1387, Sep 1992.
16. Eberman, B.S. and J. Kenneth Salisbury, Jr., "Application of Change Detection to Dynamic Contact Sensing," MIT AI Lab Memo No. 1421, March, 1993.
17. Salisbury, J.K., et al., "Look and Feel: Haptic Interaction for Biomedicine," Progress Report for the period October 1, 1994 through September 30, 1995, ARPA Contract Number DAMD17-94-C-4123, Nov 1995.
18. Salisbury J.K. and M. A. Srinivasan, "Scientific and Technical Report: Development of Haptic Interfaces," Contract: N61339-96-K-0002, CDRL Number: A002 Naval Air Warfare Center Training Systems Division, ORLANDO, FL, Feb 1997.
19. Salisbury, J.K., A. Madhani, C. Tarr, M. Ottensmeyer, D. Green and P. Lee, "Look and Feel: Haptic Interaction for Biomedicine," Progress Report for the period October 1, 1995 through September 30, 1996, ARPA Contract Number DAMD17-94-C-4123, Nov 1996.
20. Salisbury, J.K., A. Madhani, "Look and Feel: Haptic Interaction for Biomedicine," Progress Report for the period October 1, 1996 through September 30, 1997, ARPA Contract Number DAMD17-94-C-4123, Nov 1997.

6. Invited Lectures

- Sep 1981, "The Design and Control of a Dexterous Mechanical Hand," 1981 ASME Computer Conference, Minneapolis, MN. (with C. Rouff)
- Jan 1982, "A Robot Hand Design and Control Framework," AT&T Bell Labs, Homdell, NJ.
- Apr 1982, "Design and Control of a Robot Hand," National Bureau of Standards, Gaithersburg, MD.
- Nov 1982. "Dexterous Hand for a Robot," GTE Laboratories, ATL Division, Waltham, MA.
- Jul 1983, "Articulated Hand Kinematic and Force Analysis," IBM Europe Institute, Grassau, Germany.
- Jul 1983, "The Design of the Stanford/JPL Hand," INRIA, Paris, France.
- Sep 1983, "The Design of the Stanford/JPL Hand," University of Massachusetts, Amherst, MA.
- Oct 1983, "A Novel Contact Sensing Approach," DARPA Innovation Workshop for Mechanical Innovations in Robotics, Menlo Park, CA.
- May 1984, "Robot Hand Control," General Motors Research Labs, Warren, MI.
- Jun 1984, invited discussant, Ro.Man.Sy 1984, Udine, Italy.
- Jun 1984, "Articulated Hand Design and Control," CNRS/LAAS Toulouse, France.
- Jul 1984, "Articulated Hand Design and Control" Electrotechnical Labs, Tsukuba, Japan.
- Oct 1984, "Force and Position Control of a Robot Hand," Carnegie-Mellon University, Robotics Institute, Pittsburgh, PA.
- Dec 1984, "Robot Hand Kinematic Analysis," Robotics Seminar, Harvard University, Cambridge, MA.
- Apr 1985. segment in "Miraculous Machines," National Geographic Special. (Issued as video tape entitled "Miniature Miracle: The Computer Chip," National Geographic Society, 1985.)
- May 1985, "An Experimentation Environment for Robot Hand Manipulation," Robotics Seminar, Stanford University, Stanford, CA.
- May 1985, "An Experimentation Environment for Robot Hand Manipulation," Science Center, Rockwell International, Thousand Oaks, CA.
- May 1985, "An Experimentation Environment for Robot Hand Manipulation," Mechanical Engineering Dept., Ohio State University, Columbus, OH.
- Jul, 1985, "Design, Sensor, and Control Issues for Grasping and Manipulation with a Robot Hand," Engineering Foundation Conference, Biomechanics & Neural Control of Movement: Sensor Based Movement, Henniker, NH.
- Sep, 1985, "Hand Grip Design for a Force Reflecting Master," NASA/JPL, Pasadena CA.
- Oct 1985, "Potentials for Dextrous Remote Manipulation," CEA (French Atomic Energy Agency) - Teleoperator Division, Paris, France.
- Nov 1985, Segment in "Taking the Biscuit," BBC TV Robotics Special, London, UK.
- May 1986. Segment in "Nerves of Steel," BBC Radio Interview, London, UK.
- Oct 1986, "Autonomous and Human Controlled Robot Hands," MIT Sea Grant Program Symposium on Undersea Manipulation, Cambridge, MA.
- Sep 1986, invited discussant Ro.Man.Sy 1986, Cracow, Poland.

Nov 1986, "New Design Ideas for the JPL Force Reflecting Hand Controller," NASA/Jet Propulsion Labs, Pasadena, CA.

Dec 1986, "Force Reflecting Articulated Hand Masters," NASA/Jet Propulsion Labs, Pasadena, CA.

Feb 1987. Segment on Salisbury Hand, Discover Science TV Program.

Feb 1987, "Integration of Touch Sensing with Articulated Hands," Sandia National Labs, Albuquerque NM.

Feb 1987, "Analytical and Experimental Techniques for Articulated Hand Design," Distinguished Lecturer Series, Department of Mechanical Engineering, University of Wisconsin, Madison, WI.

Mar 1987. Film of Salisbury Hand at Boston Museum of Science, Boston, MA.

May 1987, "Integration of Hand and Arm Control for Space Applications," Grumman Aerospace, Bethpage, New York.

Jun 1987-present. Film of Salisbury Hand at Boston Computer Museum, Boston, MA.

Sep 1987, "Whole Arm Manipulation," ONR Workshop on Haptics & Sensory Guided Motor Control, Falmouth, Cape Cod.

Oct 1987, "Design for Force Control," MIT Mechanical Engineering Department Seminar on Force Control, Cambridge, MA.

Oct 1987, "Design Proposal for Dextrous Underwater Manipulator," DARPA, Washington, D.C.

Feb 1988, "System Design of WHOI/MIT Whole Arm Manipulator," DARPA, Washington, D.C.

Mar 1988, "Control Architecture for Implementing Hand Reflex Control," NASA/Johnson Space Center, Houston, TX.

Apr 1988, "Teleoperator Hand Calibration," Arthur D. Little Corp., Cambridge, MA.

Apr 1988, Tutorial: "Manipulation of Multiple Fingers," IEEE International Symposium on Robotics and Automation, Philadelphia, PA.

May 1988, "Overview of Hand Control," Odetics Corp., Anaheim, CA.

May 1988, "Flight Qualification Issues for the JPL Force Reflecting Hand Controller," NASA/JPL, Pasadena, CA.

May 1988, "MIT WAM Arm," Stanford University Mechanical Engineering Department, Stanford, CA.

May 1988, "Remote Robot Hand and Arm Challenges," Workshop on Robotics Needs for the Exploration of the Moon and Mars," NASA/Ames Research Center, Moffett Field, CA.

Oct 1988, "Overview of Hand and Arm Research at MIT's AI Lab," SME-MIT Robotics Conference, Cambridge, MA.

Dec 1988. Interview in "Why Can't a Robot Be More Like a Man?" New York Times.

Jan 1989, "Interaction between Dexterity and AI," Invited Panel Member, NASA/JPL Conference on Space Telerobotics, Pasadena, CA.

Jan 1989, "Fundamentals of Dextrous Manipulation," International Ocean Technology Congress, Honolulu, HI.

Oct 1989, "Whole Arm Manipulation: Mechanics and Control," California Institute of Technology, Mechanical Engineering Department, Pasadena, CA.

Jul 1990, "How Not To Make A Bad Situation Worse," DOE/Industry/University/Lab Forum

on Robotics for Environmental Restoration, Waste Managements and Waste Minimization, Albuquerque, New Mexico.

Aug 1990, "Overview of Hand and Arm Research at MIT" NASA/Ames Research Center, Mtn. View, CA.

Nov 1990, "Robotics Research at MIT's AI Lab.," IBM Academy of Technology, Annual Meeting, Cambridge, MA. Invited presenter/discussant.

Nov 1990, "Automatic Grasping and Whole Arm Manipulation," Columbia University, New York, New York. Also to be presented at the University of Massachusetts, Amherst MA., Nov 1990.

Nov 1990, "Whole-Arm Manipulation and Sensing," NSF/DARPA Workshop on Identification of Specifications for a Mobile Platform with Material Handling Capabilities, University of Pennsylvania, Philadelphia, PA.

Apr 1991, "Whole-Arm Control and Utilization in Hazardous Environments," Invited panel member in workshop on "The Application of Robotics to the Handling of Hazardous Wastes, Materials, and Equipment," at the 1991 IEEE International Conference on Robotics and Automation, Sacramento CA.

Oct 1991, co-chair and speaker at MIT Industrial Liaison Program Telerobotics Symposium, Cambridge, MA.

Jan 1992, "Automatic Grasping and Whole Arm Manipulation," Carnegie-Mellon Robotics Institute, Pittsburgh, PA.

Sep 1992, "Automatic Grasping and Whole Arm Manipulation," Keynote Speaker, IMACS/SPIE Conference, Kobe, Japan.

Oct 1992 "Automatic Grasping and Whole Arm Manipulation," Keynote Speaker, 23rd ISIR Barcelona Spain.

Nov 1992, "Haptic Interfaces," invited talk at the Annual Meeting of the American Acoustical Society, New Orleans, LA.

Feb 1993, "Haptics," Invited presentation at meeting of the National Academy of Sciences Special Committee on Virtual Reality, Washington DC.

Feb 1994, "Toward Dexterous Manipulation for Hazardous Environments," invited lectures, Korean Atomic Energy Research Institute (KAERI), Taejon, N. Korea.

May 1994, "The PHANToM Haptic Interface," invited presentation at AAAI Spring Symposium Series, Toward Physical Interaction and Manipulation, Stanford, CA.

Jan 1995, "Progress in Haptic Simulation," Invited Participant, ARPA Workshop on Telemedicine, Medicine Meets VR, San Diego.

Jan 1995, "Grasp Assessment and Automatic Grasping - Haptic Challenges," Invited presentation, NASA/JPL, Pasadena CA.

Mar 1995, "Whither Force Feedback?," Invited Panelist, IEEE-VRAIS '95, Research Triangle Park, NC.

Apr 1995, "Haptic Rendering" Invited presentation, ACM Symposium on Interactive 3D Graphics, Monterey, CA.

Jan 1996 "Feeling Compliant Materials," Invited Participant, ARPA Workshop on Haptics, Medicine Meets VR, San Diego, CA.

Apr 1996, "The Basics of Haptic Interfaces and Rendering Techniques," invited presentation, MIT ILP Symposium on Telemedicine, Cambridge, MA.

Jan 1996 "Look and Feel: Haptic Simulation and Telesurgical Systems," Invited Participant, ARPA Workshop on Haptics, Medicine Meets VR, San Diego, CA.

Apr 1996, "Review of Robotic Force Control Mechanisms and Techniques," invited seminar, Intuitive Surgical Corp, Palo Alto, CA.

Apr, 1997 "Haptic Rendering of Implicit Surfaces," invited live demonstration, ACM Symposium on Interactive 3D Graphics, Providence RI.

Jun 1997 "From Force Control to Force Display, " Invited Plenary Session, 5th International Symposium on Experimental Robotics, Barcelona Spain, June 1997.

Jun 1997 "Dexterous Systems" Invited tutorial, Workshop on Autonomous Robotic Systems, Institute of Systems and Robotics, University of Coimbra, Portugal.

Oct 1997 "Haptic Geology" Seminar at NASA JPL, Pasadena CA.

May 1998 "Touching and Being Touched: Robot Hands, Arms and Haptic Interfaces," Intelligent Mechanisms Seminar, NASA/Ames Research Center, Moffet Field, CA

May 1998 "Touching and Being Touched: Robot Hands, Arms and Haptic Interfaces," Stanford AI-Vision-Robotics Colloquium, Stanford, CA

March 1999 "Surgical Robotics," invited presentation, Commonwealth Medical Officers Meeting, Sydney Australia.

March 1999 "Touching and Being Touched: Robot Hands, Arms and Haptic Interfaces," Research Colloquium, Australian National University, Dept. of Systems Engineering, Canberra, Australia

September 1999 "Telerobotic Surgery," Invited Lecture, Society for Minimally Invasive Therapy, Westin Copley Place, Boston

October 1999 "What is VR?" Invited Lecture, American College of Surgeons Annual Meeting, San Francisco, CA

November 1999 "Haptics and Telesurgery," Invited Lecture, Stanford Medical Device Seminar: Leaders and Visionaries, Stanford, CA

March 2000 "Haptics and Telesurgery," Invited Lecture, Stanford Computer Form Annual Meeting, Stanford, CA

April 2000 "Hands On: Haptics and Telesurgery," Plenary Session, IEEE Int. Conference on Robotics and Automation, San Francisco, CA.(pending)

Record of Research Funding for J. Kenneth Salisbury, Jr.

7/82-9/91	Systems Development Foundation "Basic Research in Robotics" Winston, Brady Salisbury responsible for substantial portion of robot hand research.	\$5,584,831
9/86-5/92	Office of Naval Research, URI Program "Research on Robotics" Winston and Lozano-Peréz Salisbury acted as co-principal investigator with responsibility for proposal writing and robot arm research.	\$7,575,708
5/87-7/88	Sandia National Labs "Touch Sensor" Patrick Winston Salisbury responsible for proposal writing and research.	\$35,000
9/88-6/92	NASA/Johnson Space Center (JSC) "Automatic Grasping" Salisbury	\$201,562
1/89-10/90	Sandia National Labs "Force Sensing Fingertip Investigation" Salisbury	\$54,500
7/91-5/92	Sandia National Laboratories "Touch Sensing For Robot Hands" Salisbury	\$28,000
2/92-7/92	EXOS, Inc. "Compliant Artificial Muscles for Telerobotics" Salisbury	\$16,253
4/92-8/93	Sandia National Laboratories "Artificial Muscles I" Salisbury	\$49,998
6/92-5/97	Office of Naval Research, URI Program "Human/Robot Hands: Mechanics, Sensorimotor Functions, and Cognition" Srinivasan, Salisbury	\$2,194,599
7/92- -	Sloan Foundation, MIT "Fast Eyes" Salisbury, Slotine	\$94,000
1/93-2/00	NASA/Jet Propulsion Labs (JPL) "Vision and Touch Guided Grasping" Salisbury, Slotine	\$1,270,250

4/93-9/94	NASA/Johnson Space Center (JSC) "Stable Grasping of Objects Using Vision and Touch Information" Salisbury, Slotine	\$33,000
9/93-9/94	Naval Air Warfare Center Training Systems Div. (NAWC/TSD) "Development of a Tool Handle Haptic Interface" Salisbury	\$175,000
9/93-2/95	Office of Naval Research (ONR) "Evaluating Virtual Env. Tech. for Naval Training Applications" Zeltzer, Durlach, Srinivasan, Salisbury, Held, Sheridan, Hogan Salisbury responsible for substantial portion of proposal and research relating to haptics.	\$750,000
12/93-6/95	Sandia National Laboratories "Polymer Gel Actuator" Kenneth Salisbury	\$56,961
1/94-9/97	Advanced Research Project Agency (ARPA) "Look and Feel: Haptic Interaction for Biomedicine" Salisbury	\$810,000
10/94-7/96	Korean Atomic Energy Research Institute (KAERI) "Highly Dexterous Manipulative Techniques" Salisbury	\$120,000
4/95-4/98	Office of Naval Research (ONR) "Artificial Muscles" Salisbury	\$289,950
8/95-4/96	Boston Dynamics, Inc. "Haptic Interface Technology for Maintenance Training" Salisbury	\$103,297
2/96-5/97	Naval Air Warfare Center Training Systems Div. (NAWC/TSD) "Development of Haptic Interfaces" Salisbury, Srinivasan	\$439,703
5/97-5/00	Office of Naval Research, ASSERT Program "A Compliant Robot Hand" Salisbury	\$149,280
4/99-4/00	NASA/Ames Research Center "MarsScape" Salisbury	\$150,000
5/99-4/00	Mass General Hospital "Measurement and Display of Haptic Properties for Surgical Simulation" Salisbury (additional 50K pending)	\$150,000

9/99-8/02	NSF (and Stanford cost sharing) "Design and Development of a Testbed for a New Generation of Robots" Khatib, Roth and Salisbury	\$672,015
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Theses Supervised by J. Kenneth Salisbury, Jr.

Summary:

	Total	Completed	In Progress
S.B.	15	14	1
S.M.	28	28	0
Engineers	0	0	0
Doctoral			
As Supervisor	9	6	3
As Reader	25	23	2

S.B. Theses

- Brock, David L., "Strain Gage Based Force and Tactile Sensors," Jun 1984.
- Oberoi, Pankaj, "I/O Control Optimization on the MIT-WAM," May 1991. (EECS)
- Saito Steven R., "Characterization Contact Events," May 1991. (EECS)
- Tom, Alfred C., "Study of Sensor-Mediated Velocity-Based Robotic Grasping Behaviors in a Two-Finger Four-Joint Hand," Jun 1991.
- Everett, Derek L., "Development and Analysis of a Robotic Sensor Interface," May 1992. (EECS)
- Massie, Thomas H. "Design of a Three Degree of Freedom Force-Reflecting Haptic Interface," SB thesis, MIT EECS Department, May 1993.
- Page, James, "The MIT Wrist/Hand: Mounting and Finger Redesign," May 1993.
- Swarup, Nitish, "Design and Control of a Two-Axis Gimbal System for Use in Active Vision," May, 1993.
- Hoeg, Hans D., "Development of Virtual Objects of Arbitrary Shape," May 1994.
- Kim, Euree Y. "An Example of 3-D Object Localization and Connectivity in Object-Grasping Applications," May 1996.
- Sallum, Hani M., "Design of the Rocky 7 Modular End-Effector," May 1996.
- Goodwin, W. Alexander, "Minimalistic Force-Feedback Device: Reducing Cost of Haptic Interfaces," June 1997.
- Brave, Scott B., "Tangible Interfaces for Remote Communication and Collaboration," June 1998. (School of Architecture)
- Tarr, Christopher M., "Rigid, Plastic, and Visco-Elastic Surface Interaction," Feb 1998. (EECS - Advanced Undergraduate Project)

S.M. Theses

- Gehlbach, Garth E. "The Design and Implementation of a Multipurpose End Effector," Jan 1985. (also used for S.B. Degree)
- Chiu, Stephen L., "Generating Compliant Motion of Objects with an Articulated Hand," Jun 1985.
- Abramowitz, Jeff, "Design and Control of a Redundant Mechanism for Small Endpoint Motion," Aug 1985 (EECS).
- Brock, David, "Enhancing the Dexterity of a Robot Hand Using Controlled Slip," May 1987.
- Paul, Benjamin J., "A Systems Approach to the Torque Control of a Permanent Magnet Brushless Motor," Aug 1987.

Tabor, Keith A., "The Real-Time Digital Control of a Regenerative Above-Knee Prosthesis," May 1988 (Dual Degree - S.M. in Mechanical and Electrical Engineering). (co-supervised with Prof. Flowers, Mechanical Engineering Department).

DiPietro, David M., "Development of an Actively Compliant Underwater Manipulator," May 1988 (MIT/Woods Hole Joint Program, Department of Oceanography and Oceanographic Engineering). (co-supervised with Dr. Yoerger, WHOI.)

Eberman, Brian S., "Whole-Arm Manipulation: Kinematics and Control," Jan 1989.

Greiner, Helen, "Passive and Active Grasping with a Prehensile Robot End-Effector," May 1990 (EECS). AI-TR 1235.

Levin, Michael D., "Design and Control of a Closed Loop Torque Actuator," May 1990. AI-TR 1244.

Fullam, Scott F., "CONAN: A Four Degree of Freedom Arm for Use on a Mobile Platform," May 1990 (EECS, also used for S.B. Degree in EECS).

Chammas, Camille Z., "Analysis and Implementation of Robust Grasping Behaviors," Jun 1990. AI-TR 1237.

Hove, Barbara M., "A Study of 3-D Robotic Catching," Jun 1991. (Co-supervisor with Prof. Slotine, ME Dept.)

Moyer, Thomas H. "The Design of an Integrated Hand and Wrist Mechanism," Feb, 1992.

Anderson, Catherine, "The Design of a Compact Actuator System for a Robotic Wrist/Hand," Feb, 1992.

Zilles, Craig, "Haptic Rendering with the Tool-Handle Haptic Interface," May 1995.

Swarup, Nitish, "Haptic Interaction with Deformable Objects Using Real-Time Dynamic Simulation," Sep 1995.

Massie, Thomas H., "Initial Haptic Explorations with the Phantom: Virtual Touch Through Point Interaction," Feb 1996.

Cadapan, Loreli "Autonomous Rock Acquisition for a Microrover to be Used in Planetary Exploration," Feb 1997. (EECS)

Koontz, Bryan S., "A Multiple Vehicle Mission Planner to Clear Unexploded Ordnance From A Network of Roadways," June 1997. Also available as Draper Laboratory Technical Report CSDL-T-1285.

Liu, Trudy "Embedding Interactive Haptive Objects in HTML," May 1997. (EECS, also fulfilled SB degree)

Latimer, Craig, "Haptic Interaction with Virtual Rigid Objects Using Real-Time Dynamic Simulation," Aug 1997.

Shah, Vinay, "Design and Control of a Nonlinearly Compliant Robotic Finger," Aug, 1997.

Theobald, Daniel A., "Arbitrated Robot Control on the Web, System Design and Implementation," Dec, 1997.

Anthony, Brian W., "Anisotropic Wave Guides - Propagation, Focusing and Dispersive Phenomena with Applications for Non-Destructive Testing," Jan 1998.

Green, Donald F., "Haptic Simulation of Naturally Occuring Textures and Soil Properties," June 1998.

Ben-Ur, Ella, "Development of a Force-Feedback Laparoscopic Surgery Simulator," Sept 1999.

Katz, Arrin "The Design and Application of a Nonlinear Series Compliance Actuator for Use in Robotic Arms," Sept 1999.

Curtis, Andrew W. "A Nonlinearly Compliant Transmission Element for Force Sensing and Control," January, 2000.

Engineer's Theses

N/A

Doctoral Theses, Supervisor

Townsend, William T., "The Effect of Transmission Design on Force-Controlled Manipulator Performance," Apr 1988. AI-TR 1054.

Brock, David L., "A Sensor Based Strategy for Automatic Robotic Grasping," Jan 1993.

Eberman, Brian S., "Contact Sensing: A Sequential Decision Approach to Sensing Manipulation Contact Features," Feb, 1995. AI-TR 1534.

Morrell, John B., "Parallel Coupled Micro-Macro Actuators," Jan 1996. AI-TR 1563.

Leveroni, Susanna R., "Grasp Gaits for Planar Object Manipulation," Feb 1997.

Madhani, Akhil J. "Design of Teleoperated Surgical Instruments for Minimally Invasive Surgery," Sept 1997.

Ottensmeyer, Mark, "In Vivo Sampling of Biomaterial Properties: Instrument Development, Data Acquisition and Property Extraction," expected Jun 2000

Hong, Jesse "Adaptive Digging," expected Dec 2000

Anthony, Brian W. "Subsurface Imaging Methods," expected Jun 2001

Doctoral Theses, Reader

West, Harry, "Kinematic Analysis for the Design and Control of Braced Manipulators," Jun 1986.

An, Chae H. "Trajectory and Force Control of A Direct Drive Arm," Sep 1986. (EECS) MIT AI-TR-912.

Das, Hari, "Kinematic Control and Visual Display of Redundant Teleoperators," Apr 1989.

Buzan, Forrest T., "Control of Telemanipulators with Time Delay: a Predictive Operator Aid with Force Feedback," May 1989.

Li, Weiping, "Adaptive Control of Robot Motion," Apr 1990. (Aeronautics and Astronautics Department)

Chang, Pyung H., "Analysis and Control of Robot Manipulators with Kinematic Redundancy," May 1987. MIT AI-TR 1021.

Eppinger, Steven D. "Modeling of Robot Dynamic Performance for Endpoint Force Control," Sep 1988. MIT AI-TR 1072.

Schempf, Hagen, "Comparative Design, Modeling and Control Analysis of Robotic Transmissions," Aug 1990. (MIT/WHOI Joint Program in Oceanography and Oceanographic Engineering). WHOI-90-43.

Vaaler, Erik G., "Automated Assembly in the Presence of Significant System Errors," Dec 1990.

Siegel, David M., "Pose Determination of a Grasped Object Using Limited Sensing," May 1991. (Department of Electrical Engineering and Computer Science). MIT AI-TR 1300.

Chin, Kan-Ping, "Stable Teleoperation with Optimal Performance," expected Mar 1991.

Sturman, David J., "Whole-Hand Input," Dec 1991. (Department of Architecture).

McCarragher, Brenan J. "A Discrete Event Dynamic Systems Approach to Robotic Assembly Tasks," Jul 1992.

Yang, Hyun S., "Sub-time-optimal Control for Point-to-point Operations of Robot Manipulators," Sep 1992.

Liu, Sheng, "Task-Level Robot Adaptive Control Based on Human Teaching Data and Its Application to Deburring," Dec 1992.

Caine, Michael E. "The Design of Shape from Motion Constraints," Dec 1992.

Yang, Boo-Ho, "Progressive Learning and its Application to Robotic Control," Jan 1994.

Kang, Sing-Bing, "Robot Instruction by Human Demonstration," Nov 1994. (Robotics Institute, Carnegie-Mellon University).

Niemeyer, Gunter D., "Using Wave Variables in Time Delayed Force Reflecting Teleoperation," Sept 1996. (Department of Aeronautics and Astronautics)

Son, Jae S., "Integration of Tactile Sensing and Robot Hand Control," May 1996. (Division of Applied Sciences, Harvard University)

Voyles, Richard, "Toward Gesture-Based Programming: Agent-Based Haptic Skill Acquisition and Interpretation," Aug 1997. (Robotics Program, Computer Science Dept, Carnegie Mellon University)

Schloerb, David, "Adaptation of Perceived Depth Related to Changes of the Effective Interpupillary Distance in Computer-Graphic Stereoscopic Displays," May 1997.

Snow, Edward R., "Advances in Grasping and Vehicle Contact Identification: Analysis, Design and Testing of Robust Methods for Underwater Robot Manipulation," April 1999. (Dept of Mechanical Engineering and Applied Ocean Physics and Engineering)

Robinson, David W. "Series Elastic Actuation," expected May 2000.